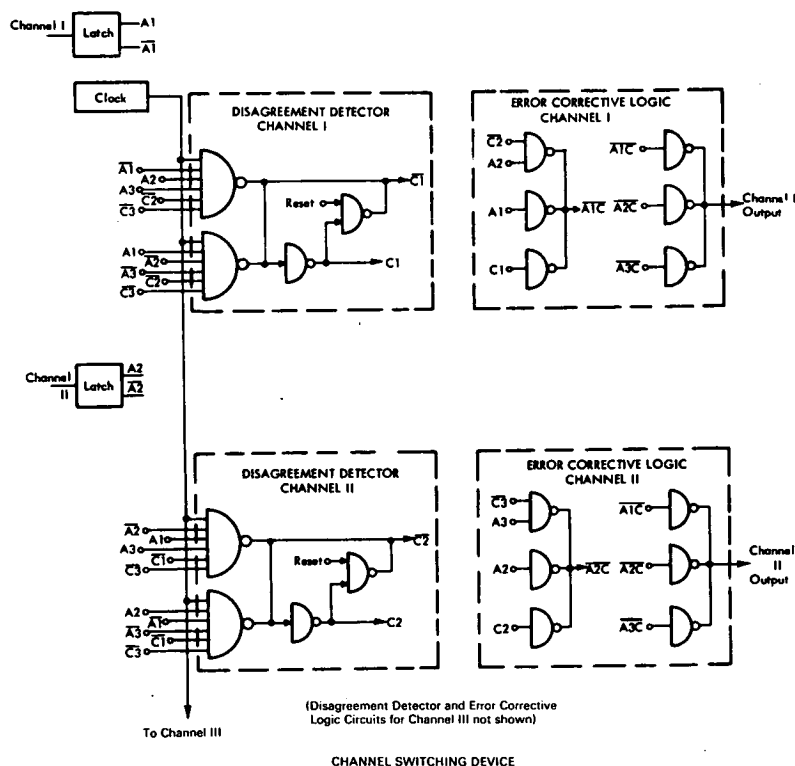


# NASA TECH BRIEF



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## Automatic Channel Switching Device



### The problem:

In existing triple modular redundant (TMR) equipment, majority voters are used as failure correction devices. A majority voter compensates for an error in one and sometimes two of its input channels. (Two input failures can be corrected when they occur in opposite directions.) With a failure in one channel, both the remaining channels must agree or one of the channels must fail in an opposite direction of the first failure in order for the equipment to function

properly. Both remaining channels affect the proper functioning of the system, therefore reliability in most cases is less than that of comparable simplex equipment.

### The solution:

The channel switching device shown operates with all three TMR channels when there are no errors. The disagreement detector outputs  $\overline{C1}$ ,  $\overline{C2}$ , and  $\overline{C3}$  remain at the "1" level;  $C1$ ,  $C2$ , and  $C3$  remain at the "0" level. The channel outputs are the same as the inputs.

(continued overleaf)

### How it's done:

When the first failure occurs, the disagreement detector outputs for the incorrect channel change to the opposite level ( $C="1"$ ;  $\bar{C}="0"$ ). The error correcting logic uses only one of the remaining channel inputs to generate all three of the channel outputs. (A failure in channel 1 switches channel 3 input to the channel outputs, etc.) Since only one channel must operate correctly after the first failure, reliability of this section of the equipment will be better than that of conventional TMR equipment after the first failure.

### Notes:

1. In conventional TMR machines, disagreement detectors (DD) sense errors by comparing the three voter (V) inputs or the three voter outputs. The detectors from each module are then "or"ed together for an error detection display. Failures are not isolated to a specific channel. Channel and module switching are required to isolate the failure.

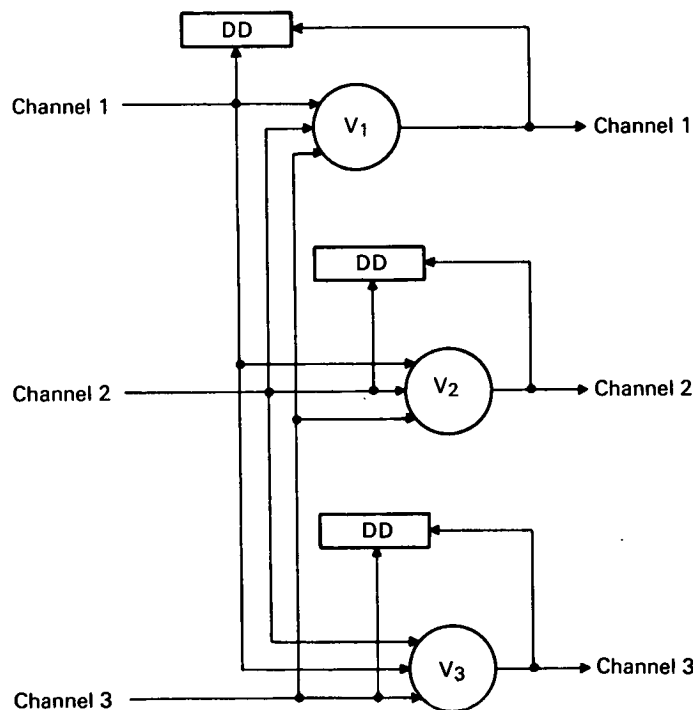
2. Errors are isolated to a specific channel by comparing one voter input with the voter output for each channel as shown. This will test the voters as well as the channel and isolate the error to a specific channel.
3. Inquiries concerning this invention may be directed to:

Technology Utilization Officer  
Manned Spacecraft Center  
Houston, Texas 77058  
Reference: B67-10086

### Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: H. T. Olnowich and M. Ball  
of IBM Corporation  
under contract to  
Manned Spacecraft Center  
(MSC-832 and 834)



DISAGREEMENT DETECTOR ACROSS VOTER